1. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 20x^3 - 81x^2 + 102x - 40$$

   A. $z_1 \in [-4.5, -3.6]$, $z_2 \in [-3.3, -1.7]$, and $z_3 \in [-0.39, 0.33]$

   B. $z_1 \in [0.4, 1.6]$, $z_2 \in [0.6, 2.1]$, and $z_3 \in [1.36, 2.65]$

   C. $z_1 \in [0.4, 1.6]$, $z_2 \in [0.6, 2.1]$, and $z_3 \in [1.36, 2.65]$

   D. $z_1 \in [-3.6, -1.7]$, $z_2 \in [-1.4, -0.8]$, and $z_3 \in [-0.98, -0.56]$

   E. $z_1 \in [-3.6, -1.7]$, $z_2 \in [-1.4, -0.8]$, and $z_3 \in [-0.98, -0.56]$

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2. What are the *possible Integer* roots of the polynomial below?

$$f(x) = 2x^4 + 4x^3 + 5x^2 + 4x + 5$$

   A. $\pm 1, \pm 2$

   B. $\pm 1, \pm 5$

   C. All combinations of: $\dfrac{\pm 1, \pm 2}{\pm 1, \pm 5}$

   D. All combinations of: $\dfrac{\pm 1, \pm 5}{\pm 1, \pm 2}$

   E. There is no formula or theorem that tells us all possible Integer roots.

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3. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^3 + 41x^2 - 40x - 48$$

   A. $z_1 \in [-0.64, 0.17]$, $z_2 \in [2.2, 3.67]$, and $z_3 \in [3.19, 4.17]$

   B. $z_1 \in [-4.17, -3.99]$, $z_2 \in [-1.28, -0.53]$, and $z_3 \in [1.15, 1.56]$

   C. $z_1 \in [-2.06, -1.17]$, $z_2 \in [0.41, 1.08]$, and $z_3 \in [3.19, 4.17]$

D. $z_1 \in [-1.09, -0.54]$, $z_2 \in [1.26, 1.72]$, and $z_3 \in [3.19, 4.17]$

E. $z_1 \in [-4.17, -3.99]$, $z_2 \in [-1.92, -0.98]$, and $z_3 \in [0.14, 0.89]$

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4. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{20x^3 + 65x^2 - 47}{x + 3}$$

A. $a \in [16, 24], b \in [-3, 8], c \in [-18, -13]$, and $r \in [-3, 5]$.

B. $a \in [16, 24], b \in [-22, -12], c \in [55, 64]$, and $r \in [-290, -285]$.

C. $a \in [-64, -53], b \in [-118, -114], c \in [-346, -342]$, and $r \in [-1084, -1080]$.

D. $a \in [-64, -53], b \in [244, 248], c \in [-736, -732]$, and $r \in [2158, 2159]$.

E. $a \in [16, 24], b \in [125, 129], c \in [374, 381]$, and $r \in [1073, 1088]$.

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5. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{8x^3 - 20x^2 - 56x + 37}{x - 4}$$

A. $a \in [31, 33]$, $b \in [-150, -144]$, $c \in [535, 540]$, and $r \in [-2111, -2106]$.

B. $a \in [4, 10]$, $b \in [12, 13]$, $c \in [-11, 1]$, and $r \in [4, 11]$.

C. $a \in [4, 10]$, $b \in [-55, -50]$, $c \in [148, 155]$, and $r \in [-573, -566]$.

D. $a \in [31, 33]$, $b \in [107, 113]$, $c \in [370, 377]$, and $r \in [1541, 1545]$.

E. $a \in [4, 10]$, $b \in [1, 5]$, $c \in [-48, -42]$, and $r \in [-96, -92]$.

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6. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{4x^3 - 75x + 123}{x + 5}$$

A. $a \in [-1, 8], b \in [-26, -21], c \in [69, 70]$, and $r \in [-294, -289]$.

B. $a \in [-24, -19], b \in [99, 102], c \in [-584, -574]$, and $r \in [2991, 2999]$.

C. $a \in [-24, -19], b \in [-102, -99], c \in [-584, -574]$, and $r \in [-2753, -2750]$.

D. $a \in [-1, 8], b \in [19, 21], c \in [19, 27]$, and $r \in [245, 253]$.

E. $a \in [-1, 8], b \in [-22, -14], c \in [19, 27]$, and $r \in [-5, -1]$.

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7. Factor the polynomial below completely, knowing that $x - 4$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 16x^4 - 16x^3 - 217x^2 + 25x + 300$$

A. $z_1 \in [-3.7, -2.8]$, $z_2 \in [-1.39, -1.21], z_3 \in [1.02, 2.4]$, and $z_4 \in [3.6, 4.4]$

B. $z_1 \in [-3.7, -2.8]$, $z_2 \in [-1, -0.8], z_3 \in [0.52, 0.96]$, and $z_4 \in [3.6, 4.4]$

C. $z_1 \in [-5.5, -3.7]$, $z_2 \in [-0.63, -0.22], z_3 \in [2.81, 3.19]$, and $z_4 \in [4.2, 5.6]$

D. $z_1 \in [-5.5, -3.7]$, $z_2 \in [-1, -0.8], z_3 \in [0.52, 0.96]$, and $z_4 \in [2.2, 3.4]$

E. $z_1 \in [-5.5, -3.7]$, $z_2 \in [-1.39, -1.21], z_3 \in [1.02, 2.4]$, and $z_4 \in [2.2, 3.4]$

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8. Factor the polynomial below completely, knowing that $x + 2$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 9x^4 - 12x^3 - 92x^2 - 32x + 64$$

A. $z_1 \in [-2.7, -1.7]$, $z_2 \in [-1.36, -1.3], z_3 \in [0.54, 0.71]$, and $z_4 \in [3.4, 4.8]$

B. $z_1 \in [-2.7, -1.7]$, $z_2 \in [-0.78, -0.72]$, $z_3 \in [1.49, 1.6]$, and $z_4 \in [3.4, 4.8]$

C. $z_1 \in [-4.7, -3.8]$, $z_2 \in [-0.27, -0.17]$, $z_3 \in [1.98, 2.01]$, and $z_4 \in [3.4, 4.8]$

D. $z_1 \in [-4.7, -3.8]$, $z_2 \in [-1.54, -1.42]$, $z_3 \in [0.7, 0.81]$, and $z_4 \in [0, 2.5]$

E. $z_1 \in [-4.7, -3.8]$, $z_2 \in [-0.74, -0.66]$, $z_3 \in [1.28, 1.44]$, and $z_4 \in [0, 2.5]$

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9. What are the *possible Integer* roots of the polynomial below?

$$f(x) = 3x^4 + 2x^3 + 5x^2 + 7x + 7$$

A. $\pm 1, \pm 7$

B. All combinations of: $\dfrac{\pm 1, \pm 7}{\pm 1, \pm 3}$

C. $\pm 1, \pm 3$

D. All combinations of: $\dfrac{\pm 1, \pm 3}{\pm 1, \pm 7}$

E. There is no formula or theorem that tells us all possible Integer roots.

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10. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 + 39x^2 + 78x + 49}{x + 3}$$

A. $a \in [-18, -13]$, $b \in [91, 98]$, $c \in [-202, -200.4]$, and $r \in [648, 653]$.

B. $a \in [-2, 8]$, $b \in [21, 27]$, $c \in [13.7, 15.7]$, and $r \in [2, 11]$.

C. $a \in [-2, 8]$, $b \in [15, 16]$, $c \in [17.7, 18.1]$, and $r \in [-24, -16]$.

D. $a \in [-2, 8]$, $b \in [57, 60]$, $c \in [248.6, 250.1]$, and $r \in [793, 800]$.

E. $a \in [-18, -13]$, $b \in [-16, -12]$, $c \in [32.1, 34.2]$, and $r \in [144, 149]$.
